

Problems:

- *Radon:*

EPA estimates that about 20,000 lung cancer deaths each year in the U.S. are radon-related. Exposure to radon is the second leading cause of lung cancer after smoking. Radon is an odorless, tasteless and invisible gas produced by the decay of naturally occurring uranium in soil and water. Radon is a form of ionizing radiation and a proven carcinogen. Lung cancer is the only known effect on human health from exposure to radon in air.

Radon in air is ubiquitous. Radon is found in outdoor air and in the indoor air of buildings of all kinds. EPA recommends homes be fixed if the radon level is 4 pCi/L (picocuries per liter) or more. Because there is no known safe level of exposure to radon, EPA also recommends that Americans consider fixing their home for radon levels between 2 pCi/L and 4 pCi/L. The average radon concentration in the indoor air of America's homes is about 1.3 pCi/L. It is upon this level that EPA based its estimate of 20,000 radon-related lung cancers a year upon. It is for this simple reason that EPA recommends that Americans consider fixing their homes when the radon level is between 2 pCi/L and 4 pCi/L. The average concentration of radon in outdoor air is 0.4 pCi/L or 1/10th of EPA's 4 pCi/L action level.

For smokers the risk of lung cancer is significant due to the synergistic effects of radon and smoking. For this population about 62 people in a 1,000 will die of lung-cancer, compared to 7.3 people in a 1,000 for never smokers. Put another way, a person who never smoked (never smoker) who is exposed to 1.3 pCi/L has a 2 in 1,000 chance of lung cancer; while a smoker has a 20 in 1,000 chance of dying from lung cancer. Figure A compares the risks between smokers and never smokers; smokers are at a much higher risk than never smokers, e.g., at 8 pCi/L the risk to smokers is six times the risk to never smokers.

The radon health risk is underscored by the fact that in 1988 Congress added Title III on Indoor Radon Abatement to the Toxic Substances Control Act. It codified and funded EPA's then fledgling radon program. Also that year, the Office of the U.S. Surgeon General issued a warning about radon urging Americans to test their homes and to reduce the radon level when necessary (U.S. Surgeon General).

Unfortunately, many Americans presume that because the action level is 4 pCi/L, a radon level of less than 4 pCi/L is "safe". This perception is altogether too common in the residential real estate market. In managing any risk, we should be concerned with the greatest risk. For most Americans, their greatest exposure to radon is in their homes; especially in rooms that are below grade (e.g., basements), rooms that are in contact with the ground and those rooms immediately above them.

- *Other chemicals*
 - Formaldehyde
 - Pesticides

- VOC's Volatile organic compounds (VOCs) are emitted as gases from certain solids or liquids.
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- *Smells:*
 - Bathroom & Kitchen smells. Pets.
- *Moisture damage*
- *Health/Alergies:*
 - Short term

Immediate effects may show up after a single exposure or repeated exposures. These include irritation of the eyes, nose, and throat, headaches, dizziness, and fatigue. Symptoms of some diseases, including asthma, hypersensitivity pneumonitis, and humidifier fever, may also show up soon after exposure to some indoor air pollutants.

Long Term

Other health effects may show up either years after exposure has occurred or only after long or repeated periods of exposure. These effects, which include some respiratory diseases, heart disease, and cancer, can be severely debilitating or fatal.

Second hand smoke

Indoor wood or cooking smoke

Mold and moisture

Environmental triggers.

To ensure adequate ventilation, the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE) says that the living area of a home should be ventilated at a rate of 0.35 air changes per hour or 15 cubic feet per minute (cfm) per person, whichever is greater.

The consensus of the engineering community, expressed through the ASHRAE process, is that a natural infiltration rate of 0.35 ACH measured using the accepted techniques will result in adequate indoor air quality most of the time for most homes. ASHRAE settled on a recommended air change rate of 0.35 ACH for residential structures as a balance of health (indoor air quality) concerns against the desire for energy conservation. It is understood to be a rough and imperfect approximation of how a healthy, energy-efficient home should perform on average. It is this static target to which the current MHCSS sets the bar, and which existing ventilation methods strive to attain.

Solutions:

- Natural ventilation
 - Air seeping through cracks, open doors, open windows, etc.
 - Tightly built homes designed to reduce heating and air conditioning costs lower the amount of natural ventilation
 - Windows and doors are unreliable because it depends on the outdoor weather,
 - Requires human intervention. Humans are unreliable
- Whole house
 - Exhaust
 - Requires ductwork to cover most of the rooms
 - You can put the fan in the attic
 - Creates pressure imbalance
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 - Supply
 - Doesn't replace air as fast as exhaust
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 - Balanced
 - Best option for pressure balance
 - Requires double the ductwork
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 - Balanced heat recovery
 - Air to air heat exchanger. Temperate air that is exiting the house is used to heat up or cool down the outside air before it enters the house.
 - Adds cost, but is more efficient.
 - HVAC integration
 - Using furnace blower can be very inefficient
 - Allows for use of the already-installed ductwork.
 - Exhaust Air Heat Pump
 - Expensive but more efficient
- Local pollution vents
 - Bathroom and kitchen usually
 - Only solves certain problems.
 - Crawlspace seeping is not addressed
 - These fans are usually loud and inefficient

- - Doesn't evenly distribute air throughout the house, sometimes causing drafts
- Control options.
 - Necessity for some automatic control because people will forget about it
 - Fully automatic
 - Timer system
 - Integration with HVAC unit controls